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Your petitioner, William J. Berry, a citizen of the United States and a resident of the city of Durham, State of North Carolina, whose post office address is 3518 Medford Road, Durham, North Carolina 27705, prays that Letters Patent may be granted to him for improvements in a CONTROL VALVE AND WATER PURIFICATION METHOD as set forth in the following specification.

CONTROL VALVE AND WATER PURIFICATION METHOD

FIELD OF THE INVENTION

The invention herein pertains to water purification using ion exchange resins and particularly pertains to a continuous loop purification method using a control valve for selective purified water withdrawal.

DESCRIPTION OF THE PRIOR ART  
AND OBJECTIVES OF THE INVENTION

Water is considered highly purified when it has a minimal electrical resistance of 18 meg ohms per centimeter at 25°C. Water of such high purity can easily become contaminated and therefore circulation through a loop has frequently been used with various devices such as laboratory faucets and the like. Constant circulation insures purity while preventing stagnation which accommodates bacterial growth. High purity water is of vital importance in today's manufacturing plants that produce electronic circuitry, chips and other high tech components and equipment. Also, high purity water is a must in kidney dialysis and many other medical procedures. Thus, while it is not difficult to produce 18 meg ohms water, it is difficult to constantly maintain this purity over long periods of time for use on an "as needed" basis.

Based on the constant need for high purity water, the present invention was conceived and one of its objectives is to provide a

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continuous loop purification method which will allow the user to tap as much or as little 18 meg ohms water as needed for a particular application.

It is still another objective of the present invention to provide a water purification method which provides water of high purity in a continuous loop using ultraviolet light and ion exchange.

It is yet another objective of the present invention to provide a control valve to allow high purity water to be selectively withdrawn therefrom without contaminating the remaining water.

It is also an objective of the present invention to provide a control valve which provides a manually operated spool which is both simple to use and inexpensive to manufacture and distribute.

Various other objectives and advantages of the present invention will become apparent to those skilled in the art as a more detailed description is set forth below.

#### SUMMARY OF THE INVENTION

The aforesaid and other objectives are realized by providing a continuous water purification loop having a manually operable control valve therein. The control valve allows the user to withdraw a selected amount of the highly purified water as the water circulates. The control valve includes a handle for manual manipulation of a central spool residing in a duct within the valve housing. The duct

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has a series of axially spaced, parallel grooves therealong with o-rings therebetween. The spool includes a plurality of longitudinal channels which allow water to pass from an inlet port on the housing to either first outlet or second outlet ports, or to both for as great or as little flow through second outlet port as desired. Thus, the spool can be regulated so purified water which does not exit from the second or use outlet port to remain in the loop for continued purification at a flow rate of approximately .75 gal/min. By manually selectively turning the spool a very small quantity of purified water can be withdrawn as needed (up to .75 gallons/minute) for example to a faucet, while allowing any undrawn water to continue along the loop. The control valve has only a few parts and prevents stagnation which can lead to biological growth and impurity of the water.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a water purification loop with the control valve of the invention therein;

Fig. 2 shows an enlarged view of the control valve as removed from the loop;

Fig. 3 demonstrates in a partial schematic fashion a first position of the spool relative to the housing inlet and exit ports;

Fig. 4 features yet another partial schematic view of the spool as shown in Fig. 3; and

Fig. 5 depicts another partial schematic view of yet another position of the spool relative to the inlet and exit ports.

DETAILED DESCRIPTION OF THE PREFERRED  
EMBODIMENTS AND OPERATION OF THE INVENTION

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For a better understanding of the invention and its operation, turning now to the drawings, Fig. 1 demonstrates the preferred method of purifying water at a constant with water purification loop 10 which includes water source 11 such as from a municipal water system which furnishes potable water under pressure. The incoming water first flows to prefilter 12 and to control valve 13 which regulates the water flow and prevents water having an electrical resistance less than 500,000 ohms per centimeter from passing through pump 14. Water travels from one-way control valve 13 through pump 14 which increases the water pressure, into ultraviolet radiation chamber 15 whereby wave lengths of light in the 2500-3500 A° wavelength are thus used to kill bacteria, mold, algae, protozoa and other types of microorganisms. The ultraviolet irradiated water then passes into carbonous resin bed 16 having a carbon resin preferably such as Ambersorb XE-348 (Rohn & Haas Corporation) and on to ion exchange resin bed 17. Ion exchange resin bed 17 has preferably an anion resin type such as Amberlite 410 (Rohn & Haas) and a cation type resin such as Rohn & Haas IR-120. Other suitable resins may also be used as understood by those skilled in the water treatment art. Flow through water purification loop 10 is preferably .75 gal/min (2.839 l/min) although larger or smaller capacity loops may be configured as desired.

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The water passes next to temperature controller 18 which maintains the radiated water at preferably about 25°C. The water next passes to polishing bed 19, also consisting of a mixture of anion and cation exchange resins as may be furnished by Rohm & Haas Company of Philadelphia, PA. Water leaving polishing bed 19 is directed preferably through conventional conductivity meter 20 whereby the electrical resistance of the water in meg ohm/centimeters may be read. Various types of electrical resistance meters may be used as are provided by many different manufacturers. Water passing must have a minimum 18 meg ohm/centimeters reading and if not the water flow is terminated by use of standard electrical switches (not shown).

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From conventional conductivity meter 20 water thereafter passes to control valve 21 shown in more detail in Figs. 2-5. Control valve 21 is the preferred embodiment of the control valve of the invention and includes handle 27 which is attached or molded to spool 22. Spool 22 is preferably formed from an acetal resin sold by E. I. DuPont Company of Wilmington, Delaware under the mark Delrin. This Delrin polymeric material is both rigid and durable as required for this application.

As shown in Fig. 2, spool 22 snugly fits in duct 23 of housing 24 and is rotatable by handle 27. Housing 24 includes threaded spool cap 25 attached to housing 24 which engages threads 26 on spool 22.

As also shown in Figs. 2-5, spool 22 includes a plurality of longitudinal channels 29 for conducting water therealong. O-rings

30A-D as shown in Figs. 2-5 prevent water from passing along the outer surface of spool 22 except when channels 29 are encountered. Channels 29 allow water to flow beneath o-rings 30A-D. Thus, as shown in Fig. 3, water entering inlet port 33 will pass along channels 29 and will exit first outlet port 34, but not second outlet port 35. In Fig. 4 spool 22 has been rotated by turning handle 27 clockwise and, as channels 29 lie beneath o-rings 30B and 30C, allows water to flow both through first outlet port 34 and through second outlet port 35. As further seen in Fig. 2, grooves 28 encircle duct 23 to allow water to freely flow between o-rings 30A-D.

In Fig. 5, handle 27 has been rotated further in a clockwise direction urging spool 22 right to left whereby channels 29 no longer lie beneath o-rings 30B. Therefore, water flows only beneath o-ring 30C to exit second outlet port 35 to faucet 38 as shown in Fig. 1, or for some other end use. By manually rotating handle 27, the water flow can be regulated to second outlet port 35 and any excess water as shown in Fig. 4 passes through outlet 34 to maintain the preferred gal/min flow rate of .75 gal/min (2.839 l/min) through preferred water purification loop 10. While handle 27 is preferably manually operated, solenoid or other automated or electric components could be configured to operate spool 22.

The illustrations and examples provided herein are for illustrative purposes and are not intended to limit the scope of the appended claims.